INDOOR AIR QUALITY ASSESSMENT

Powder House Community School
1060 Broadway
Somerville, MA 02144

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of Bob Ciampi, former Facilities Director, Somerville Public Schools (SPS), the Massachusetts Department of Public Health (MDPH), Center for Environmental Health's (CEH) Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Powder House Community School (PHCS), Somerville, Massachusetts. The request was prompted by concerns over water damage and potential mold growth. On March 9, 2004, a visit to conduct an indoor air quality assessment was made to the PHCS by Sharon Lee and Cory Holmes, Environmental Analysts in BEHA's Emergency Response/Indoor Air Quality Program (ER/IAQ).

The PHCS is a three-story cement building constructed in the 1970s as an addition to an adjacent administration building. The building is structured around a central courtyard. The first floor of the PHCS consists of general classrooms, offices, kitchen, cafeteria, library, and art room. The Somerville Family Network and Parent Information Center also occupy space on the first floor. The second floor consists of the gymnasium and classrooms. Classrooms are also located on the third floor.

Methods

BEHA staff performed a visual inspection of building materials for water damage and/or microbial growth. Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID).

Results

The school houses approximately 330 students in pre-kindergarten through eighth grade and a staff of approximately 100. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in 45 of 46 areas surveyed, indicating adequate ventilation in the building. Mechanical ventilation is provided by rooftop air handling units (AHUs). Fresh air is distributed to classrooms via ductwork connected to slotted air diffusers located between ceiling tiles (Picture 1). Return air is drawn into ceiling vents and exhausted out of the building (Picture 2). Some rooms did not have mechanical exhaust capabilities. Consideration should be given to undercutting doors for these rooms as a means of exhausting air. Lastly, the cafeteria exhaust system was deactivated at the time of the assessment. Without the exhaust system operating as designed, normally occurring pollutants cannot be removed. This allows pollutants to build up, leading to indoor air quality/comfort complaints.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room, while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years (SMACNA, 1994). The date of the last balancing was not available at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please consult Appendix A.

Temperature measurements ranged from 67^{o} F to 74^{o} F, which were below the BEHA comfort guidelines in some areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measurements in the building ranged from 19 to 29 percent, which were below the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

As discussed, the purpose of the assessment was to examine water damage. Occupants were concerned about potential mold growth in the art storage room. The art storage room is located at the rear of the building, near the adjoining building. Prior to the assessment, BEHA and Mr. Ciampi discussed the extent of water damage experienced in this particular room. During the course of these conversations, Mr. Ciampi provided a photograph of the area in question (Picture 3), and BEHA staff recommended that water damaged materials (e.g. corrugated boxes) be removed and discarded. At the time of the assessment, BEHA staff noted water damaged materials and boxes had been removed from the art storage room; however, remnants of cardboard from water damaged boxes remained adhered to two walls (Picture 4). Efflorescence was also noted on the wall (Picture 4). Efflorescence is a characteristic sign of water damage to building materials such as cement or plaster, but it is not mold growth. As moisture penetrates and works its way through exterior wall, water-soluble compounds dissolve, creating a solution. As the solution moves to the surface of the interior wall, water evaporates, leaving behind white, powdery mineral deposits. This condition indicates that water from the exterior is penetrating the building. The source of moisture also wetted cardboard boxes, which can support mold growth. During the assessment, BEHA staff recommended that the walls be cleaned and disinfected with a bleach and water solution, followed by a soap and water solution.

Efflorescence was also noted on walls and support beams in the computer storage room. Furniture and boxes were placed against many of these structures, possibly moistening these materials. BEHA staff recommended that furniture be moved away from these walls and water damaged porous materials be discarded.

Significant water damage was observed on wall and ceiling plaster, as well as on ceiling and floor tiles in the second floor stairwell adjoining the administration building

(Pictures 5 to 7). Water damage was also noted around the doorway leading to the neighboring building (Pictures 8a and 8b). Much of the damage is on the ceiling and upper wall, which suggests a roof leak exists. Building materials in the stairwell connecting the PHCS and the TAB may also be degraded because of age. Moreover, the stairwell is located in a corner where wind often drives rain into the building. Driving rain, especially, can degrade and penetrate a building. The aforementioned stairwell is also located above the Computer Storage Room. Since water damage was noted on the floor of the stairwell, water may likely be penetrating to the level below. For example, efflorescence noted on support columns in the computer storage room may be the result of water penetration from the above stairwell.

Efflorescence on the interior of a building indicates that water is penetrating from the exterior (i.e. building envelope). BEHA staff examined the building exterior side of the art and computer storage rooms for points of water penetration. A large crack in the exterior wall was noted (Pictures 9a and 9b). Holes also remain in the brick exterior from previously existing banister (Picture 10). Breaches were also seen in and around a door (Pictures 11a, 11b, and 11c). Holes, breaches, and seams are points through which water can penetrate the building, particularly under driving rain conditions. These breaches were likely sources that provided water entry and resulted in damage to the art and computer storage rooms.

Plants were growing against the foundation walls. The growth of roots against exterior walls can bring moisture in contact with the foundation. Plant roots can eventually penetrate, leading to cracks and/or fissures in the sublevel foundation. Over time, this process can undermine the integrity of the building envelope, providing a means of water entry into the building via capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

Plants were also observed in several classrooms (Picture 12). Plants, soil and drip pans can serve as sources of mold growth, thus should be properly maintained. Over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth. Plants should also be located away from ventilation sources to prevent aerosolization of dirt, pollen or mold.

Open seams between the sink countertop and wall were observed in several rooms (Picture 13). If not watertight, water can penetrate through the seam, causing water damage. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage. Moistened materials that are not dried within 24 to 48 hours can become potential sources for mold growth.

A few areas had water-damaged ceiling tiles, which can indicate leaks from the roof or plumbing system (Picture 14; Table 1). Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

Lastly, a refrigerator is located on carpeted flooring (Picture 15). When warm, moist air passes over the cooling coils, condensation can form. Condensation is the collection of moisture on a surface at or below the dew point. The dew point is the temperature that air must reach for saturation to occur. Over time, condensation can collect and form water droplets. These water droplets can drip from the refrigerator on to the carpet. Moistened carpeting can also be a source of mold growth.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

Other Concerns

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, BEHA staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of assessment, outdoor carbon monoxide concentrations were between 0 and 1 ppm (Table 1). Carbon monoxide levels measured in the school were non-detect (ND).

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter (μg/m^3) in a 24-hour average (US EPA, 2000a) These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particle levels be maintained below 65 μg/m^3 over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, BEHA uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. Outdoor PM2.5 concentrations were measured at 31 μg/m^3 (Table 1). PM2.5 levels measured in the school were between 2-9 μg/m^3, below outdoor measurements (Table 1). Frequently, indoor air levels of particulates can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulates during normal operation. Sources of indoor airborne particulate may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices, operating an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be negatively influenced by the presence of materials containing volatile organic compounds (VOCs). VOCs are carbon containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND (Table 2). Indoor TVOC concentrations were also ND.

In an effort to identify materials that can potentially increase indoor TVOC concentrations, BEHA staff examined classrooms for products containing these respiratory irritants. Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC containing products. While no TVOC levels measured exceeded background levels, materials containing VOCs were present in the school.

Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat. Spray paint canisters and rubber cement containers, which also contain VOCs, were noted (Picture 16). Rubber cement contains n-hexane or heptane, which can be irritating to the eyes, nose and throat. Local exhaust ventilation should be utilized when this material is used. As required by the federal Labeling of Hazardous Art Materials Act (LHAMA), art supplies containing hazardous materials that can cause chronic health effects must be properly labeled (USC, 1988). The use of such art supplies should be limited to times when students are not present and in areas where adequate exhaust ventilation is available. Rubber cement not only contains VOCs but also is flammable material. Rubber cement should be stored in a flameproof cabinet.

Cleaning products were found on countertops and in unlocked cabinets beneath sinks in some classrooms (Picture 17). Like dry erase materials, cleaning products contain VOCs and other chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Also of concern are unlabelled bottles and containers. Products should be kept in their original containers and be clearly labeled for identification purposes, especially in the event of an emergency.

Accumulated chalk dust was noted in some classrooms. Chalk dust is a fine particulate that can easily become aerosolized, irritating eyes and the respiratory system. Similarly, pencil shavings were observed to be accumulating at the base of pencil sharpeners (Picture 18). Open windows and operating ventilation can aerosolize chalk dust and pencil shavings.

Some building occupants at the PHCS indicated pests were a problem in the school. Measures to abate rodent problems were noted. Rodent infestation can result in indoor air quality related symptoms. Mouse urine is known to contain a protein that is a known sensitizer (US EPA, 1992). A sensitizer is a material that can produce symptoms in exposed individuals can cause running nose or skin rashes in sensitive individuals (e.g. running nose or skin rashes). A three-step approach is necessary to eliminate rodent infestation:

- Remove rodents;
- Clean waste products from the interior of the building; and
- Reduce/eliminate pathways/food sources that attract rodent.

To eliminate exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior of a building for several months after rodents are eliminated (Burge, 1995). A combination of cleaning, increase in ventilation and filtration should serve to reduce rodent associated allergens once the infestation is eliminated.

As discussed, conditions that attract pests should be reduced/eliminated. Food is an attractant to pests and rodents (e.g. food open areas (Picture 19)). Proper food storage is an integral component in maintaining indoor air quality. Food should be properly stored and clearly labeled. Reuse of food containers (e.g. for art projects) is not recommended since food residue adhering to the container surface may also serve to attract pests.

Also of note was the amount of materials stored inside classrooms (Picture 20). In classrooms throughout the school, items were seen on windowsills, tabletops, counters, bookcases and desks. The amount of items stored in classrooms provides a means for dusts, dirt and other potential respiratory irritants to accumulate. Many of the items, (e.g. papers, folders, boxes) make it difficult for custodial staff to clean. The age of stored materials should also be considered. A large collection of older periodicals and other art supplies were noted in the art room.

Dust was noted accumulated on many surfaces. A number of exhaust vents in classrooms were also noted with accumulated dust (Picture 21). Back drafts can result in re-aerosolization of accumulated dust particles. Dust can be irritating to the eyes, nose and respiratory tract.

In an effort to reduce noise from sliding chairs, tennis balls had been spliced open and placed on chair legs (Picture 22). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off gas VOCs. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix B (NIOSH, 1998).

Some building occupants also reported cigarette smoke odors outside room 231C. Smoke odors were detected by BEHA staff at the time of assessment. Environmental tobacco smoke can have a marked effect on indoor air quality. Environmental tobacco smoke is an indoor air pollutant, a respiratory irritant and can exacerbate the frequency and severity of symptoms in asthmatics. The most effective method of preventing exposure to environmental tobacco smoke is ensuring a building is smoke. free. M.G.L. Chapter 270, Sec. 22 prohibits smoking in public buildings, except in an area that has been specifically designated as a smoking area (M.G.L., 1987).

Lastly, staff indicated concern regarding the carpets. Most carpeting in the building is original and, in many of the rooms, were stained. As previously discussed, refrigerators located on carpeted floors can cause water damage to carpets. Staff indicated that carpets were difficult to clean. Given the age and conditions of carpets, consideration should be made towards removing and replacing carpets with new carpeting or floor tiling.

Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Seal all holes and breaches along the exterior walls near the adjoining administration building.
2. Contact a roofing contractor or building envelope specialist to assess the integrity of the roof, especially the area between the PHCS and adjacent building.
3. Remove cardboard adhered to walls in art storage room. Clean and disinfect area with a bleach and water solution, followed by a soap and water solution.
4. Ensure all water damaged materials are removed and disposed.
5. Consult *Mold Remediation in Schools and Commercial Buildings* published by the US EPA (2001) for more information on mold. Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
6. Remove plant growths against the exterior wall/foundation of the building to prevent water accumulation.
7. Operate both supply and exhaust ventilation continuously, independent of classroom thermostat control, during periods of school occupancy to maximize air exchange.
8. Install passive door vents or undercut doors by at least one inch to provide a source of transfer air fresh air to rooms lacking a natural or mechanical fresh air supply.
9. Consider adopting a balancing schedule for mechanical ventilation systems every 5 years, as recommended by ventilation industrial standards (SMACNA, 1994).
10. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be

adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (e.g., throat and sinus irritations).

11. Place tile or rubber matting underneath water bubblers and refrigerator in carpeted areas.
12. Seal breaches, seams, and spaces between sink countertop and backsplash to prevent water damage.
13. Ensure plants have drip pans. Avoid over watering and examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary.
14. Clean chalkboards and dry erase board trays and pencil sharpeners regularly to avoid build-up of particulates.
15. Relocate pencil sharpeners away from windows.
16. Store cleaning products properly and out of reach of students. Ensure spray bottles are properly labeled.
17. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
18. Clean exhaust/return vents periodically to prevent excessive dust build-up.
19. Discontinue use or ensure flammable products are stored in the proper cabinets.

20. Use the principles of integrated pest management (IPM) to rid the building of pest. Activities that can be used to eliminate pest infestation may include the following activities.

    a) Rinse recycled food containers. Seal recycled containers in a tight fitting lid to prevent rodent access.
    b) Remove non-food items that rodents are consuming.
    c) Store foods in tight fitting containers.
    d) Avoid eating at work stations. In areas where food is consumed, vacuum periodically to remove crumbs.
    e) Clean crumbs and other food residues from toasters, toaster ovens, microwave ovens coffee pots and other food preparation equipment on a regular basis.
    f) Examine each room and the exterior walls of the building for means of rodent egress and seal appropriately. Holes as small as ¼ inch is enough space for rodents to enter. If doors do not seal at the bottom, install weather stripping as a barrier.
    g) Reduce harborages (e.g. cardboard boxes) to prevent rodent residency.

    A copy of the IPM Guide can be obtained at the following Internet address: http://www.state.ma.us/dfa/pesticides/publications/IPM_kit_for_bldg_mgrs.pdf

21. Consider adopting the US EPA (2000b) document, *Tools for Schools*, in order to provide self assessment and maintain a good indoor air quality environment. The document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

22. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://www.state.ma.us/dph/beha/iaq/iaqhoFtme.htm.

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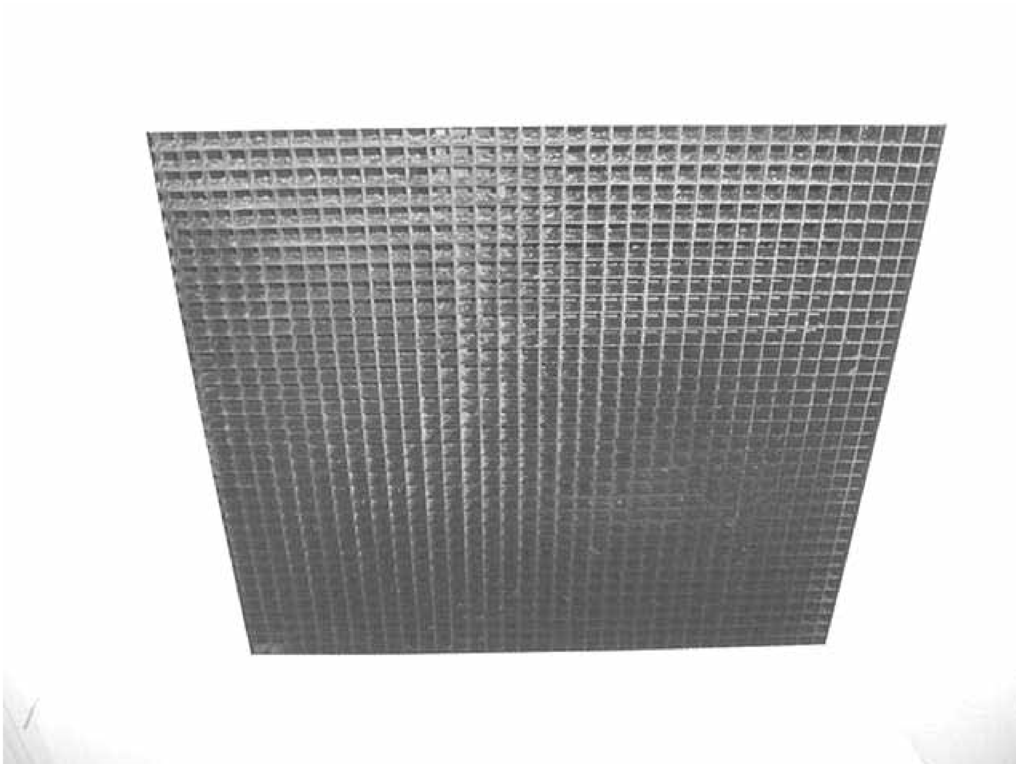
Picture 1

Ceiling tile

Fresh air diffuser

Picture 2



Exhaust vent; note dust accumulation

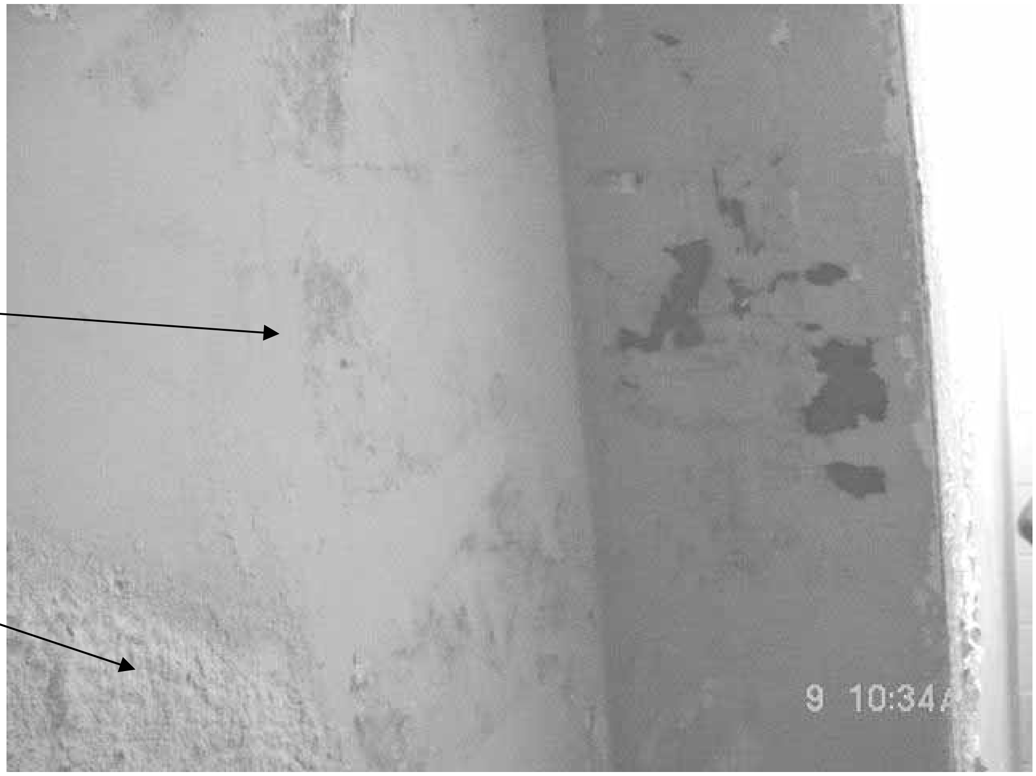
Picture 3

Water damaged wall and boxes in Art Storage Room
(provided by Robert Ciampi: 2/20/2004)

Picture 4

Box Remnants

Efflorescence



Box remnants and efflorescence on Art Storage Room Wall

Picture 5

Water damage in stairway near adjoining administration building

Picture 6

Water damaged ceiling and wall plaster

Picture 7

Water damaged floor tiles

Picture 8a

Water damage to ceiling tiles and door near adjoining building

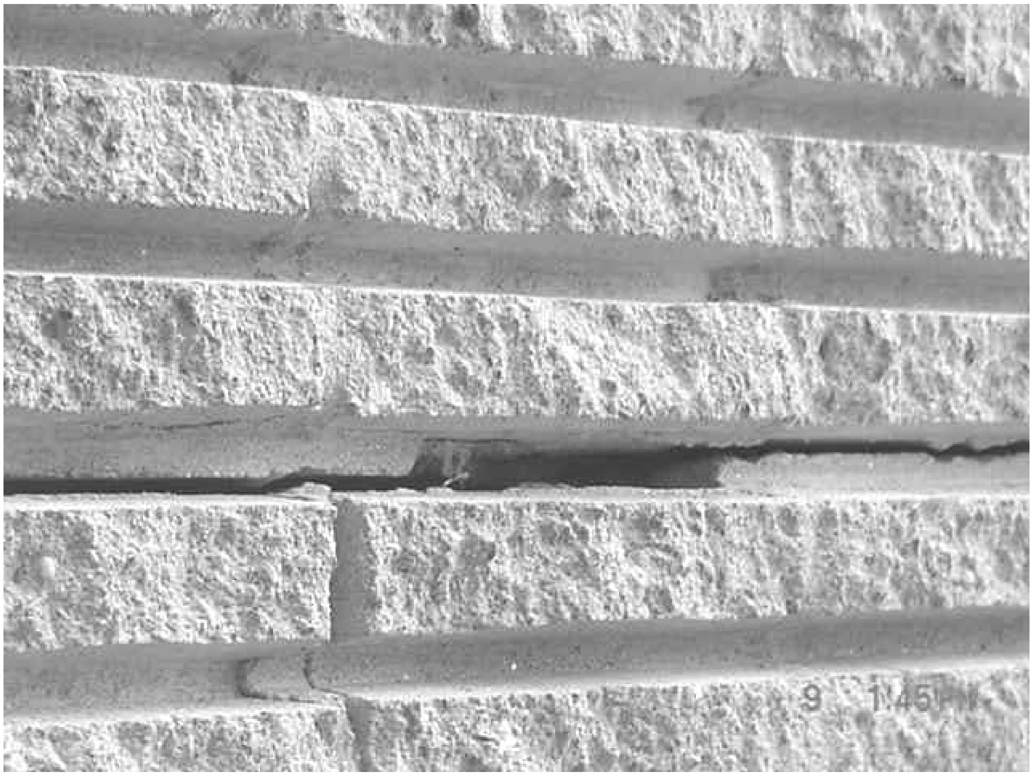
Picture 8b

Water damage and efflorescence on door and floor

Picture 9a

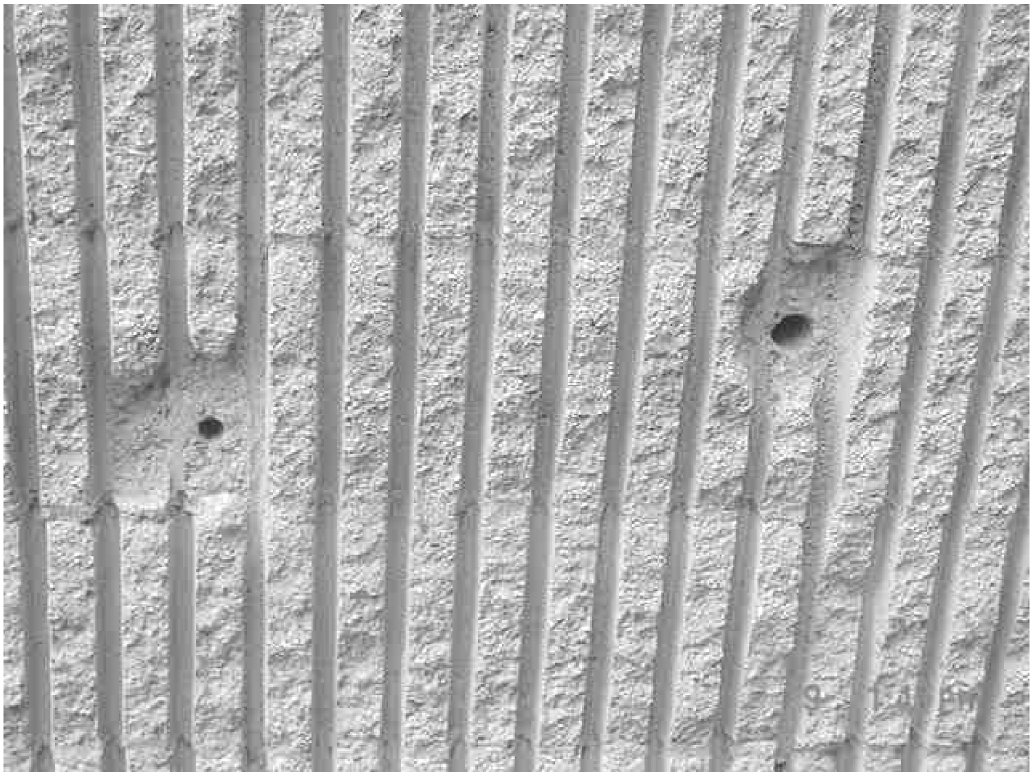
Breach spanning a substantial length of the exterior wall

Picture 9b



Close-up of breach in wall

Picture 10



Holes in wall from banister

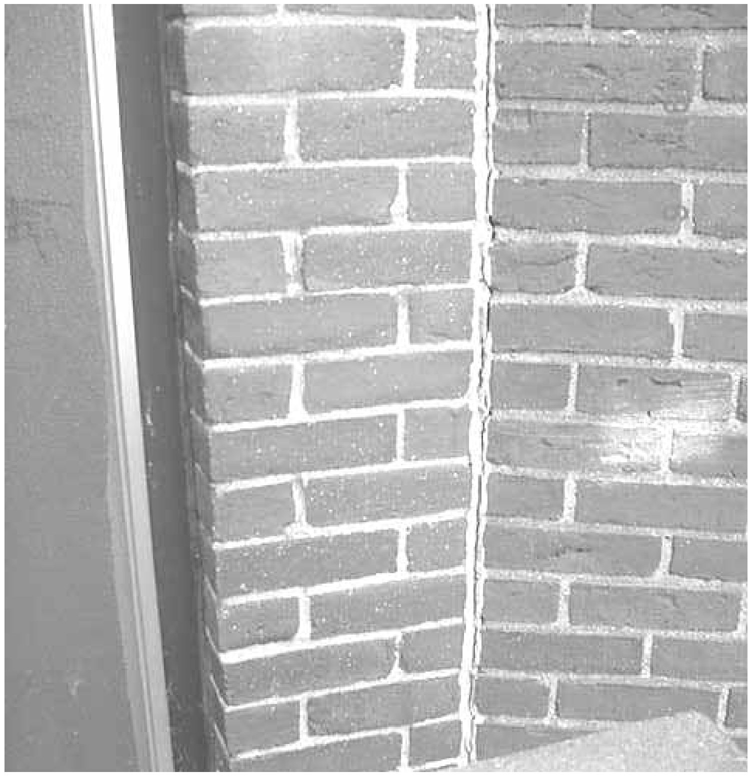
Picture 11a

Corroded doorframe between PHCS and adjoining building

Picture 11b

Damaged doorframe caulking

Picture 11c



Seam in brick mortar

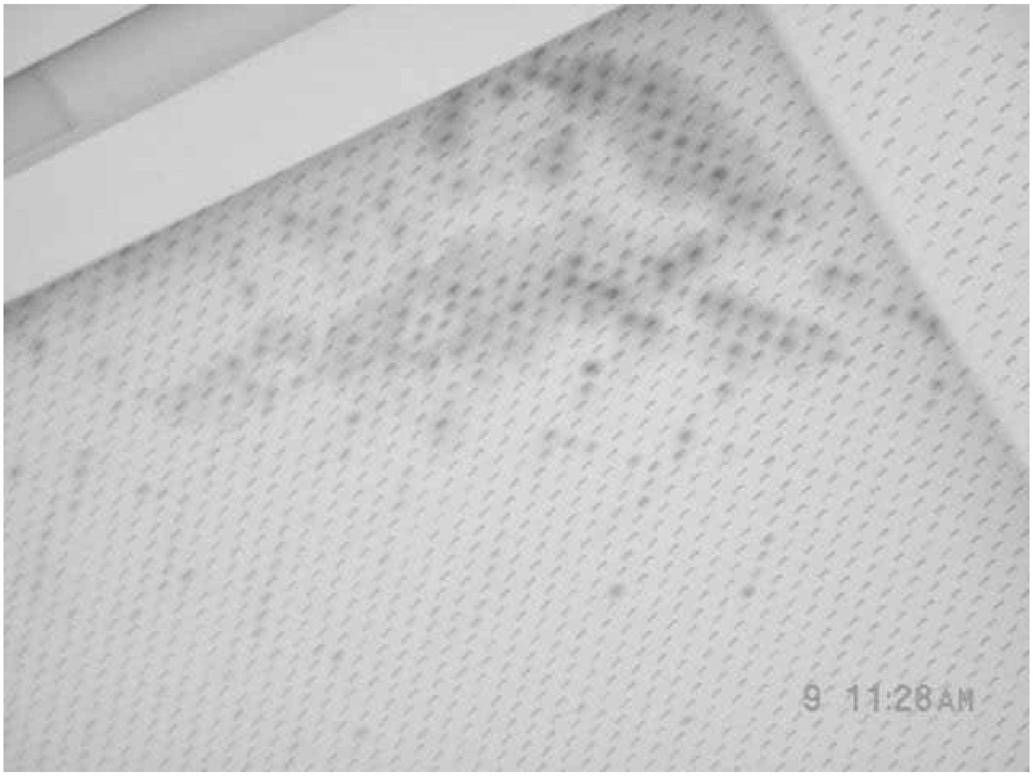
Picture 12

Plants in classroom

Picture 13

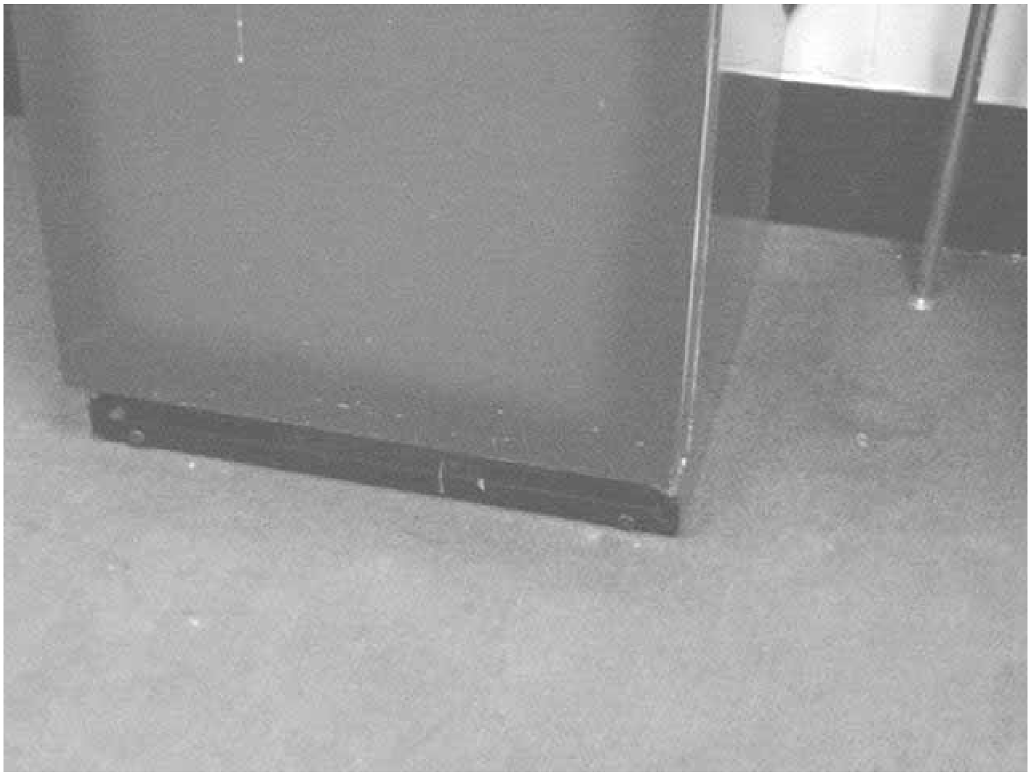
Breach between sink and backsplash

Picture 14



Water damaged ceiling tile

Picture 15



Refrigerator on water damaged carpeting

Picture 16

Rubber cement stored in classrooms

Picture 17

cleaning and paint products stored in an unlabeled cabinet

Picture 18

Pencil sharpener located above an open window

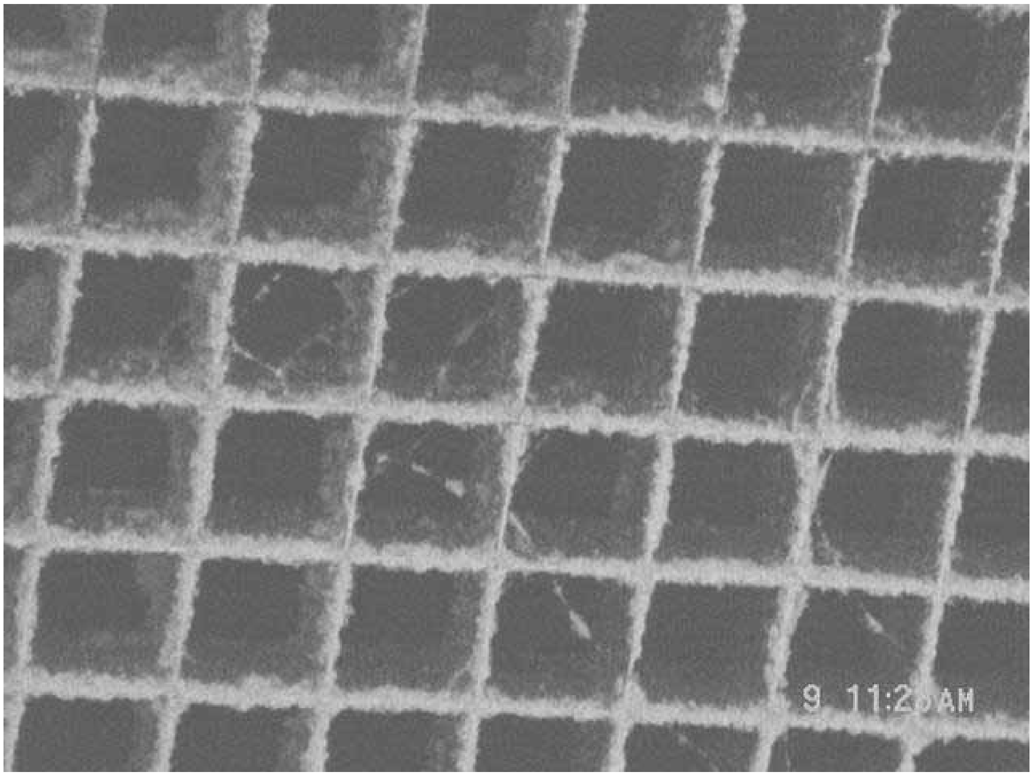
Picture 19

Food stored openly in classrooms

Picture 20

Accumulated items in classrooms

Picture 21



Dust accumulated on exhaust vent

Picture 22

Tennis balls on chair legs

Powder House Community School

1060 Broadway, Somerville MA 02144

Table 1

Indoor Air Results

March 9, 2004

Location/ Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (µg/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
Background (outdoors)	31	36	388	0-1	ND	31			-	-	
124C (Coat Room)	71	25	710	ND	ND	6	0	N	Y ceiling	Y ceiling	Inter-room door open
124D	70	25	714	ND	ND	5	21	N	Y ceiling	N	Cleaners; hallway door open
129A	72	26	779	ND	ND	5	20	Y	Y ceiling	Y ceiling	CD
129B	71	25	700	ND	ND	5	20	Y	Y	N	Breach sink/counter; TB, cleaners; hallway door open
129C	71	25	763	ND	ND	6	21	N	Y ceiling	Y 2-ceiling	
208	70	25	581	ND	ND	7	0	N	Y ceiling	Y ceiling	Hallway door open
214A	72	25	579	ND	ND	7	9	N			TB, plants

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Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
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Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Powder House Community School
1060 Broadway, Somerville MA 02144

Table 1

Indoor Air Results
March 9, 2004

Location/ Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (µg/m3)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
214B	72	24	602	ND	ND	6	19	Y	Y ceiling	Y ceiling	Hallway door open; supply blocked by clutter
216	71	23	619	ND	ND	8	4	Y	Y ceiling	N	DEM; hallway door open
223A	68	25	570	ND	ND	7	8	Y	Y ceiling	Y ceiling	PF, TB, plants; hallway door open; temperature complaints-cold in winter, hot in summer; exhaust occluded by dirt/debris
223B Speech & Language	70	26	605	ND	ND	5	5	Y	Y ceiling	Y ceiling	Cleaners, plants, latex paint; hallway door open; thermostat "missing"
223D	68	24	609	ND	ND	7	14	Y	Y ceiling	Y ceiling	DEM, clutter
231A	73	27	779	ND	ND	6	12	N	Y ceiling	Y ceiling	Breach sink/counter; WD carpet; clutter, FC re-use; inter-room door open
231B	70	29	767	ND	ND	5	15	N	Y ceiling	Y ceiling	Breach sink/counter; DEM, cleaners; exhaust occluded by dirt/debris Fridge on carpet, CD, clutter; inter-room door open; carpet cleanliness concerns

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									Supply	Exhaust	
231C	68	26	718	ND	ND	3	11	Y	Y ceiling	N	Breach sink/counter, CD, cleaners, food use/storage, items hanging from CT, paint cans under sink, unlabeled bottle; hallway door open; cigarette odor
231D	74	19	606	ND	ND	3	1	N	Y ceiling	Y ceiling	WD ceiling, CD, DEM, TB, cleaners, clutter; hallway door open
236	73	20	637	ND	ND	2	1	N	Y ceiling	Y ceiling	1 MT, CD, DEM, PS; hallway door open
249	73	30	850	ND	ND	5	5	N	Y ceiling		Hallway door open; heat issues
254	72	26	682	ND	ND	5	0	N	Y ceiling	Y ceiling	
283C	70	25	531	ND	ND	6	0	Y	Y ceiling	Y ceiling	PF, TB, cleaners; hallway door open
307A	64	82	466	ND	ND	6	0	N	Y ceiling	Y ceiling	Cleaners,; hallway door open; metallic spray paints – flammables, eye and respiratory irritant; occupants at lunch

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Powder House Community School **Indoor Air Results**

1060 Broadway, Somerville MA 02144 **March 9, 2004**

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									Supply	Exhaust	
307B	73	23	434	ND	ND	6	1	N	Y ceiling	Y ceiling	Breach sink/counter; cleaners; hallway door open; 20 occupants left room ~ 1 hr. prior
307C	72	25	692	ND	ND	7	20	Y	Y ceiling	Y ceiling	Breach sink/counter; clutter; hallway door open
307D	73	22	513	ND	ND	7	1	Y	Y ceiling	Y ceiling	Breach sink/counter; DEM; carpet cleanliness concerns
315A	68	24	604	ND	ND	7	17	Y	Y ceiling	Y ceiling	Hallway door open
315B	73	25	686	ND	ND	7	12	Y	Y ceiling	Y ceiling	CD; hallway door open; exhaust occluded by dirt/debris
315C	72	24	666	ND	ND	7	16	Y	Y ceiling	Y ceiling	Breach sink/counter; DEM, cleaners
315D	70	24	572	ND	ND	7	15	Y		Y ceiling	Breach sink/counter; DEM, cleaners; hallway door open; exhaust occluded by dirt/debris

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317	74	20	608	ND	ND	4	0	Y	Y ceiling	Y ceiling	1 WD CT
321B	69	22	519	ND	ND	4	0	Y	Y ceiling	Y ceiling	Breach sink/counter; CD, DEM, TB, cleaners, clutter, FC re-use
323A	71	23	725	ND	ND	4	21	Y	Y ceiling	Y ceiling	6 aluminum CT, 1 MT; CD, cleaners, items hanging from CT; unlabeled bottles under sink; hallway and inter-room doors open; cupric chloride crystals; exhaust occluded by dirt and dust
323B	72	21	677	ND	ND	4	5	N	Y ceiling	Y ceiling	CD, cleaners; hallway and inter-room doors open
323C	72	20	611	ND	ND	6	0	Y	Y ceiling	Y ceiling	Breach sink/counter; CD, PS, food use/storage, rubber cement; hallway door open
323D	74	19	601	ND	ND	4	0	N	Y ceiling	Y ceiling	Breach sink/counter; CD, cleaners, clutter, food use/storage, items hanging from CT; exhaust occluded by dirt/debris

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									Supply	Exhaust	
336	69	19	448	ND	ND	4	0	N	Y ceiling	N	CD, DEM
Art	67	29	627	ND	ND	5	7	N	Y ceiling	N	CD, PS, clutter, FC re-use, items hanging from CT, plants, old magazines; hallway door open
Assistant Principal	71	23	685	ND	ND	2	1	N	Y ceiling	Y ceiling	PC, laminator; hallway door open, exhaust occluded by dirt/debris
Cafeteria	68	27	775	ND	ND	6	~100	Y	Y	N	Items hanging from CT, hallway door open, stage exhaust deactivated
Computer Lab	70	25	792	ND	ND	4	0	Y	Y ceiling	N	22 computers; inter-room door open
Faculty Work Room	71	26	713	ND	ND	7	0	N	Y ceiling	Y ceiling	Breach sink/counter; hallway door open
Food Service Office	78	25	701	ND	ND	7	2	N	Y ceiling	Y ceiling	Breach sink/counter; PC, PF; hallway door open; PC near exhaust vent

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Gym	67	25	708	ND	ND	5	15	N	Y ceiling	Y ceiling	Dust
Library	68	26	775	ND	ND	6	22	Y	Y ceiling	Y wall	Dust; open to second level
Main office	70	23	713	ND	ND	3	3	N	Y ceiling	N	PC; hallway and inter-room doors open
OT/PT	70	24	680	ND	ND	1	0	N	Y ceiling	Y ceiling	Exhaust occluded by dirt/debris
Small group instruction room	71	23	549	ND	ND	9	2	N	Y ceiling	Y ceiling	TB; hallway door open; passive door vent

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